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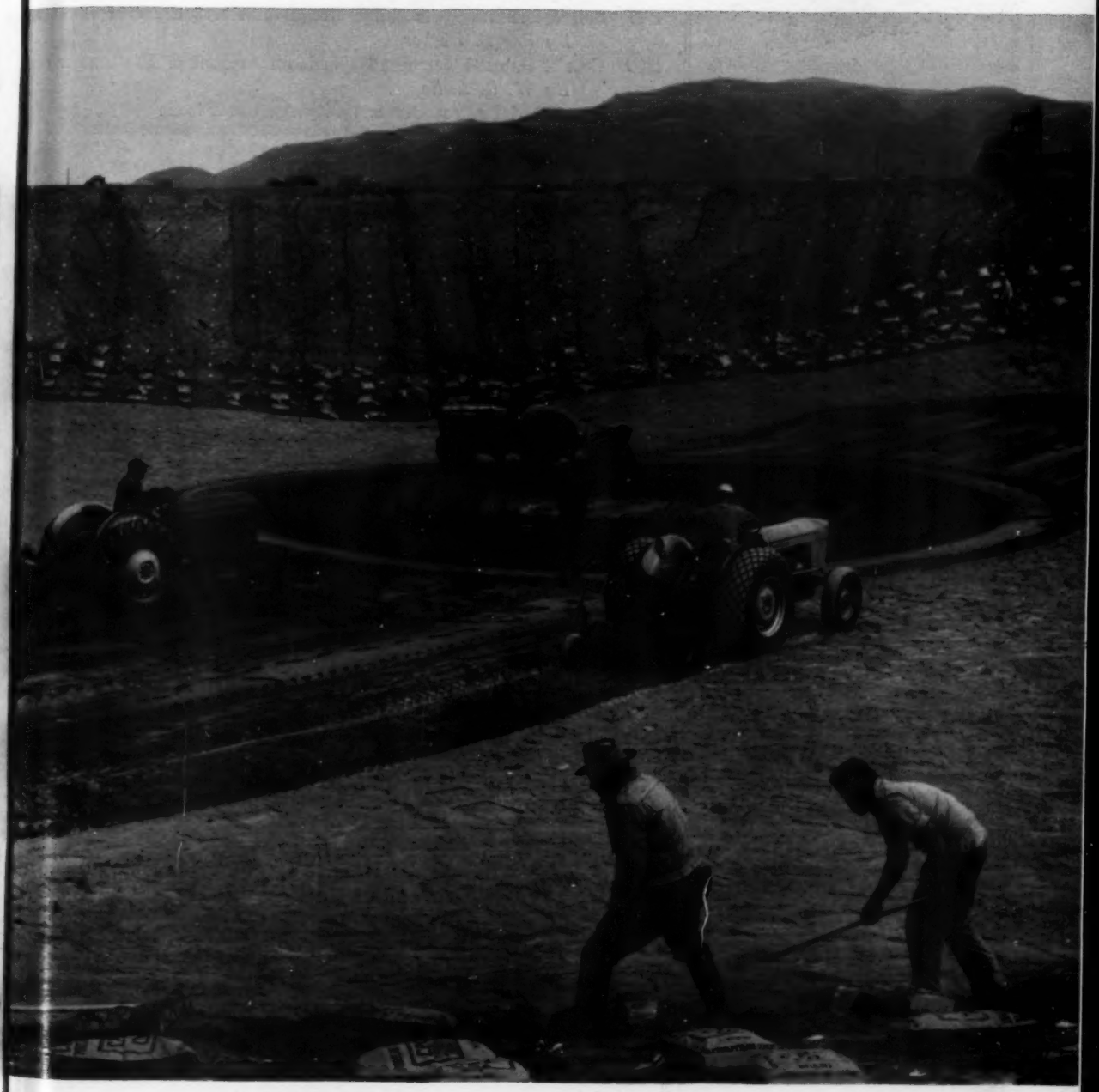

SOIL CONSERVATION SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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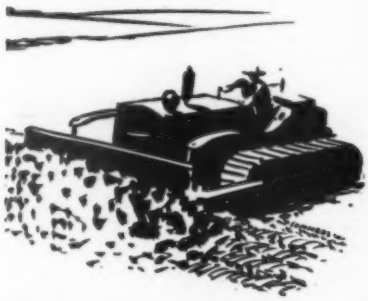

Soil Conservation
25 Years Ago

"Taking firm root in rural America —spreading like a healthy kudzu vine— is a new concept of land use. Rarely, if ever, has an agricultural principle or program or philosophy germinated so surely, so quickly, or in so many environments.

"Ideas are trail-blazers of human progress. Ideas, as distinguished from things. And it is a pioneer idea — an idea which states the logic and traces the broad pattern of a permanent husbandry—which has its blueprint in the soil conservation districts. . . .

"The picture is of minds and men in meeting, of human relationships, and social intangibles. Mass education and intensive activity; the farmer on the one side and the technician on the other; soils' problems in the same bag with economic problems; the farmer pressing to obtain service and the district staff struggling to satisfy his need: These, too, are important to the drama of a young idea hastening to maturity."

COVER PICTURE—Soil-cement lining being applied to prevent seepage of reservoir in Riverside-Corona Soil Conservation District, Horsethief Canyon, Calif. Workmen spread cement by hand and use rototillers to mix it with surface soil. Operations start at center and work in circle outward. — Photo by Earl R. Shade.

Soil Conservation

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Rural Development and Conservation

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BEN O. OSBORN, Editor

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Earthmoving Is Big Part of Soil and Water Conservation

By C. J. Francis and Sellers G. Archer

THE engines of a flying freight train speed by as you reach a crossing. Large gondola-type cars are all filled with earth, and on the side of each is printed, "Load limit, 140,000 pounds." You turn off the engine of your car to wait. It is 6 a.m. on Monday.

You know the weight of a cubic yard of earth, so you estimate that each car carries about 62 cubic yards. You count 110 cars a minute, and estimate that in 15 minutes you may see 100,000 cubic yards pass. Fascinated, you watch the freight speed endlessly by. The cargo never varies. You wait and wonder what large project is under construction.

Soon it is noon. Then it is 6 p.m., and you estimate that 80,000 cars and 5 million yards have passed. You can't wait longer, so you give up and turn back. Later you learn that the weird train blocked the crossing for 2½ days, 65 hours to be exact. A total of 428,220 cars carried 27 million cubic yards of earth by that crossing.

Of course there can't be any such train, but watershed construction under Public Law 566 in the United States caused that much earth to be moved last year.

A small army of contractors built 235 dams, improved 300 miles of stream channel, and built many other structures in 306 watersheds.

Considerably more is scheduled for 1964. State conservationists estimate the earthmoving total at more than 36 million cubic yards. About 25 million will go into 3,161 dams, 8 million will be moved from 300 miles of channels, and 3 million will be moved in other construction. It would take our phantom train 90 hours to move this load.

To get another picture, put all of this earth in one dam 30 feet high, with a 14-foot top and normal 2:1 and 3:1 side slopes—the dam would be 68 miles long!

And the conservation earthmoving job will not be finished in 1964. This is clearly shown by the study of watershed project needs in the National Inventory of Soil and Water Conservation Needs. In a nationwide survey, Federal and State agencies found that some 8,300 upstream watersheds containing about a billion acres are in need of planned programs of protection and development involving community action.

These watersheds make up about half the total area of the United States, exclusive of Alaska. The projects approved to date cover only 2.66 percent of the total land area; 2.82 percent in the east and 2.48 percent in the west. This shows how small a start has been made.

Experience to date indicates that project development is economically justified on about half of the watersheds needing treatment. The probable total cost is estimated at an average of $25 per acre. Current practice under the Watershed Protection and Flood Prevention Act (Public Law

The authors are director, Engineering Division, Washington, D. C., and field information specialist, Spartanburg, S. C., both of the Soil Conservation Service.

566) would provide about $15 per acre as the Federal share. Thus, the long-term total need for Federal investment may be in the order of $7.5 billion for watershed projects.

An analysis of structural measures included in 473 work plans for watershed projects authorized for operations as of June 30, 1963, gives some idea of the construction work these projects will generate. Its total cost is estimated at $479,200,000.

The project plans call for 3,003 floodwater-retarding dams estimated to cost $244,000,000, or 51 percent of the total for structural measures. A close second, 6,555 miles of channel improvement will cost 31 percent of the total, or $149,000,000. Multiple-purpose dams, dikes, grade stabilization structures, floodways, and diversion debris basins and other structures make up the remaining 18 percent or $86,000,000. Most of the 1,019 grade stabilization structures are in the loess areas adjoining the Missouri River in Nebraska, Kansas, Iowa, and Missouri.

The proportions between different types of structures likely will change in the future.

Since the foregoing figures were tabulated, the Act has been amended to include recreation as an authorized purpose eligible for cost-sharing. Multiple-purpose dams already are receiving greater emphasis in work plans.

Floodwater-retarding dams now authorized call for moving about 252 million cubic yards of earth. Some average dimensions, obtained from a summary of the 3,003 structures contained in work plans authorized for operations as of July 1, 1963, are:

Total cost (Federal and local)	$82,000
Fill, cubic yards	80,650
Sediment pool capacity, acre-feet	144
Floodwater pool capacity, acre-feet	895
Water supply pool capacity, acre-feet	2,230
Surface area of sediment pool, acres	28
Surface area of floodwater pool, acres	75
Surface area of water supply pool, acres	161

Channel imprqvement is the second most important type of construction. Visualize, if you will, a single continuous channel from Omaha to Washington, D. C., from Washington to Boston, from Boston to Seattle, from Seattle to Los Angeles, and from Los Angeles back to Omaha, and you will have some idea of the mileage of stream channels that had been authorized for improvement as of July 1, 1963. The excavation involved in channel work exceeds 160 million cubic yards.

But watershed construction isn't all earthmoving. This year's work will require more than 50,900 cubic yards of concrete, thousands of feet of concrete and steel pipe, acres of soil cement and rock riprap, tons of reinforcing steel, carloads of lumber for building forms, hundreds of large valves, and many other materials.

A hypothetical train that could carry this earth and other material would be 6,000 miles long!

Another monstrous train would be needed to transport men and equipment to the sites of about 316 dams, 300 miles of stream channels, and other operations on 327 watershed projects in the United States and Puerto Rico.

Although watershed construction is more spectacular, the regular land treatment applied on individual farms in soil and water conservation districts and watershed projects accounts for the major part of conservation earthwork. It is estimated that half a billion cubic yards of earth was moved in applying soil and water conservation practices in fiscal year 1963. Following are some of the major construction practices reported:

Diversions, miles	3,310
Grass waterways, acres	124,970
Ponds	53,886
Terraces, miles	40,577
Land grading and smoothing, acres	378,542
Land leveling, acres	511,125
Irrigation reservoirs	1,613
Irrigation canals, miles	538
Drainage ditches, miles	9,083
Stream channel improvement, miles	756
Grade stabilization structures	7,518
Tile drains, miles	29,125
Water spreading, acres	35,810
Ditch and canal lining, miles	1,648

Concrete and steel, as well as earth, go into major watershed structures.

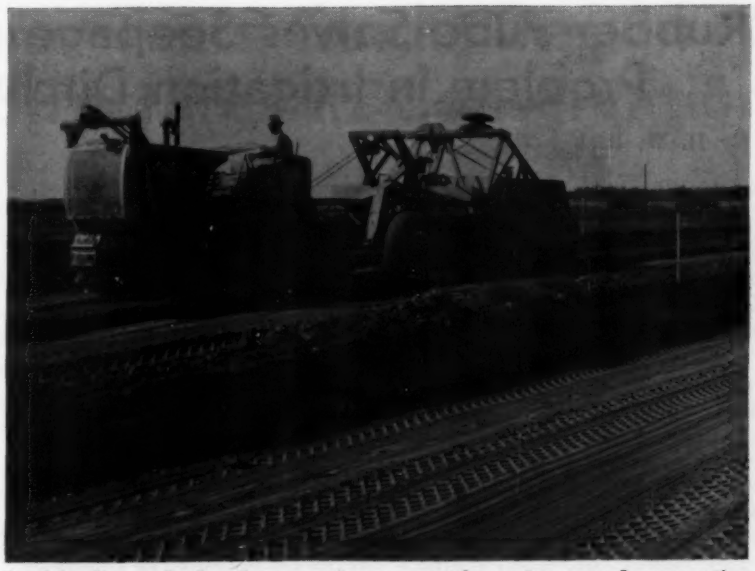
One of the major earthmoving practices on individual farms is land leveling of irrigated cropland. This practice provides a smooth field surface that enables the farmer to apply water uniformly, thus improving irrigation efficiency and reducing labor costs. More than 7 million of the 36 million acres of irrigated land in the United States has been leveled. About ½ million acres is leveled annually. Assuming an average of 400 cubic yards of earth moved per acre treated, the total annual workload is 200 million cubic yards. The cost of this one conservation construction operation is about $50 million.

Land grading and smoothing to improve field drainage is a new practice that is gaining favor with farmers. Accurate land grading eliminates shallow surface ponding, creates a uniform seed bed, and permits more efficient farming. Farmers in recent years have bought several thousand land levelers that can be drawn by farm tractors.

The Soil Conservation Service provided technical assistance on more than 36,000 acres of land grading and 342,000 acres of land smoothing during the last fiscal year.

Surface drainage systems and related practices require much earthmoving. The construction of shallow ditches by grading equipment or deep ditches by draglines is required on most flat fields to remove excess water. The SCS provided technical assistance on nearly 8,000 miles of field ditches and more than 9,000 miles of drainage mains and laterals in every section of the country during the last fiscal year.

At first glance one might think that conservation construction had reached its limits. Nothing could be farther from the truth. When these figures are related to the arable land area of the United States and the still unmet need for conservation work, the end of earthmoving is not in sight.



Land leveling and other farm practices account for major part of conservation earthmoving.

Moreover, the rapid technological progress being made in farming requires that the individual farmer constantly improve efficiency of operations to compete economically. We can, therefore, expect continuing improvements in old measures and constant expansion of conservation work, all of which will generate earthmoving operations.

DO-IT-YOURSELF CONSERVATION AT HOME

Urban and suburban lot owners in Pennsylvania's populous Montgomery County near Philadelphia were advised this year by the Wissahickon Valley Watershed Association how to carry out a do-it-yourself "Conservation At Home" project.

"No one would even consider building a house without a plan," the nonprofit citizens organization dedicated to the preservation and conservation of the beauty and natural resources of the watershed pointed out in a leaflet for homeowners. "Yet most home grounds, as important as they are to the home setting, just grow like Topsy. You owe it to yourself to plan for the proper planting and conservation of the soil and water on your own property."

The association explained how to make a conservation plan by drawing a sketch map of the property, noting conservation problems, and selecting appropriate conservation measures from a "basic 10" list provided in the leaflet. Included are:

Planting trees for shade and fuel-saving windbreaks; soil erosion control, especially on new lots, through lawn improvement, grass waterways, diversion terraces, and stabilizing steeper slopes with sod strips or vines; laying out garden rows on the contour across slopes, using alternate strips of cover crops like oats or ryegrass on tilled ground, and building a compost pile or pit; and growing plants that provide food, cover, and nesting areas for wild birds.

Rubber Tube Solves Seepage Problem in Irrigation Ditch

By H. W. Rick

WATER for 1,500 acres of fertile cropland near Red Lodge, Montana, in the Carbon Soil and Water Conservation District comes by diversion from the Clark's Fork River.

Where it crossed a 950-foot stretch of steep, unstable hillside, it ran into trouble.

Originally, the 12 participants in the Clark's Fork and Silver Tip Ditch Company built a metal flume to cross the stretch. This was all right for a time but when maintenance costs began climbing, they replaced the flume with a ditch skirting the hill.

Real trouble started then. The soil began to slip. Large cracks showed up along the canal and below it. Time after time heavy equipment was rushed to the slope for repairs.

The author is area conservationist, Soil Conservation Service, Billings, Mont.

A Soil Conservation Service geologist after a study reported the soil movement was resulting from a layer of fine clay-like material that was lubricated by moisture deep within the hill. That made the situation look hopeless. Conferences began with representatives of the Farmers Home Administration, which was financing the ditch company, as interested participants.

First this solution and that were proposed. All were discarded as being too expensive or unworkable. Somebody suggested a huge rubber tube which could move with the changing surface of the earth or which could be shifted while repairs to the earth base were made.

A Denver firm made the tube—4 feet in diameter and 875 feet long—of butyl rubber with nylon fabric reinforcement. The tube wall is less than a quarter-inch thick, which permits relatively easy handling. The entire tube can be rolled up and stored in winter. Life expectancy is reckoned at 15 years.

Small holes in the tube can be patched in about the same way automobile tires are repaired.

The tube has been doing a completely satisfactory job of delivering water to the thirsty croplands below.

Soil slip below hillside ditch resulting from irrigation water seepage.

Inlet end of butyl rubber tube used to carry water over unstable soil.

Have You Seen?...

● "Genesis and Hardening of Laterite in Soils," by Lyle T. Alexander and John G. Cady, Soil Conservation Service, USDA Technical Bulletin 1282. Laterite is a highly weathered material, found particularly in tropical countries, that hardens upon exposure to wetting and drying, as under clean cultivation and erosion. The bulletin reports on a study of the process of laterite formation in tropical Africa, in order to obtain a better understandng of soils containing laterite in the warm-temperate and subtropical Southern States, Puerto Rico, and Hawaii, with a view to improvements in their recognition, classification, and long-time productive use.

Soil Mechanics Tests Guide Design of Earth Structures in Conservation

By Rey S. Decker

A COOPERATOR in a soil conservation district needs a large stock-water dam in a dry pasture.

The president of an irrigation district asks for assistance in raising the dam of an irrigation reservoir.

The main channel of a troublesome stream must be enlarged to provide flood prevention.

The Soil Conservation Service engineers who plan, design, and construct the many kinds of projects involved in soil and water conservation programs must have reliable information about the kind of soil at each site and how it will behave as construction material.

To provide more precise information for specific jobs than can be obtained from standard soil surveys, the SCS annually tests and analyzes thousands of soil samples taken from proposed construction sites.

These tests are made by a central Soil Mechanics Laboratory at Lincoln, Nebr., and by materials testing sections of the Engineering and Watershed Planning Units at Fort Worth, Tex., Spartanburg, S. C., and Portland, Oreg. The central laboratory establishes technical standards for all the work and makes tests requiring equipment not available at the EW&P units.

As the volume of construction work serviced by SCS engineers has grown, the workload of the Soil Mechanics Laboratory has increased as well. In 1956, the laboratory conducted tests on nearly 6,400 samples from 462 sites. In fiscal year 1963, the laboratory and EW&P units tested nearly 11,000 samples and prepared recommendations for 913 sites.

When a construction job is planned where soil mechanics information will be needed, fieldmen from the State or local SCS staff make the field survey and geologic investigation. They take soil samples and forward them to the testing location with reports by the engineer and geologist. The laboratory makes the tests and prepares a report of the findings and recommendations for the design engineer responsible for the job.

Providing the information needed by the design engineer involves many technical fields. Engineering geology, soil mechanics, and foundation engineering, especially, are united in defining the engineering properties of soils and applying this knowledge to safe and practical design of structures founded upon, built with, or excavated through soil materials.

The amount of soil engineering information needed and the details of applying it vary with the nature and scope of each project. In SCS operations, earth dams make up the major part of the workload in this field. This is true not only because of the amount of this kind of construction but also because of the difficulty of predicting the exact behavior of an earth dam and its foundation during construction and after completion.

For example, all soils will transmit water, some rapidly, others

Core drill obtains samples of foundation material along centerline of watershed dam.

The author is head, Soil Mechanics Laboratory, Soil Conservation Service, Lincoln, Nebr.

Technician in soil mechanics laboratory measures consolidation of building material.

very slowly. A zone of saturation and seepage develops in earth dams that impound water for long periods. Depending on the properties of the soil used, the dam must be properly designed to prevent this seepage zone from outcropping on the downstream slope and developing a "slip zone."

Earth dams move and the movements are measurable. They may move upward, downward, or sideways. The movements are predictable, and can be compensated in the designs if the properties of the foundation and fill materials are known.

Several months' time and many engineering specialties are used in preparing plans and specifications for an earth dam. Surveys must be made of the damsite and reservoir area. The hydrology and streamflow characteristics of the watershed behind the dam must be studied and evaluated. Results of these surveys and studies are used to establish the most practical height and length of dam for the intended purpose.

Detailed investigations of surface geology and subsurface materials must be conducted. Test holes are bored in the foundation area and in areas that will supply the materials to build the dam. Samples of soil and rock from the holes are carefully classified and described. Core samples representing each kind or condition of material are collected for testing.

Many kinds of tests are used to determine the engineering properties of soil and rock materials. It is important that the tests duplicate as nearly as possible the conditions that will exist when the dam is completed. The testing program for each project is planned to provide factual data that can be used to predict the behavior of the foundation and the embankment.

Measurements of consolidation or settlement are used to predict movements of the dam and of any conduit through it.

Tests of seepage potential or permeability of the foundation and embankment are important. Deep cutoffs into the foundation or clay blankets over the reservoir bottom may be necessary to eliminate excessive foundation seepage. Drains and relief wells may be needed to reduce uplift pressure under the dam.

Tests of the strength of foundation and embankment materials indicate the needed slopes of a dam. Shear strength may dictate the placement of different kinds of soil in the embankment. Wide berms are often needed when foundation materials are weaker than the embankment.

Tests of compaction of soils are made to provide design data and are used during construction to make sure that the design is being followed.

All soils are variable; no two test holes or samples are ever exactly alike. Superior engineering judgment and experience, therefore, are needed in addition to test results to predict the ultimate behavior of the dam, the foundation, and the reservoir.

Practical Information For Community Planners

Practical information on intelligent long-range planning for the use of land and water resources is presented in a 30-page publication on " A Citizen's Development Plan for Every County" recently published by the University of Wisconsin Extension Service. The illustrated circular, by Walter A. Rowlands of the Department of Agricultural Economics of the College of Agriculture at Madison, has national application.

The foreword by J. H. Beuscher, law professor at the University, says in part:

"Today, increasingly, automotive and technological development, urban sprawl, recreational mushrooming and declines in rural population are pushing forward great and growing citizen interest in local community planning, that is, in study, analysis, and forethought about the future of one's own home area.

"As Americans we have rationally planned our homes, our farms, our businesses. Now we are at last anxious to plan our communities, too. As a result, citizens once willing to let Jones do it are ready to pitch in and devote long hours to land use or economic base studies, to educational, transportation, or recreational surveys and the like. How to organize and go about these tasks—this is what this circular is all about.

"But citizens alone cannot do the job. Mr. Rowlands shows how you can enlist the help of technically trained people now working in your community—soil conservationists, recreationalists, agricultural advisers, school men, and others. In addition he points to the trained professional planner as a vital source of help. By getting John Q. Citizen involved in the planning process, however, a basis for community understanding and acceptance of expert suggestion is laid."

Cost of Parallel Terraces Depends Largely on Amount of Earthmoving

By W. C. Little

ROUGH fields with short rows can be transformed into smooth fields with long rows to permit efficient operation of the large machinery required by modern farming. The conversion often requires a great deal of earthmoving, but the resulting savings in operating costs in most cases more than pay for the change. Recent studies in the Piedmont area of Georgia and South Carolina show that machinery operating efficiency may be increased as much as 24 percent with parallel terraces and parallel crop rows.

Almost always, some earthmoving or landforming is required before parallel terraces can be constructed. Gullies, old bench terraces, dead furrows, and other irregularities on a field must be smoothed. The amount of soil that must be moved can be reduced to a minimum by careful planning that takes advantage of existing drainage and erosion patterns. For example, placing vegetated waterways in natural depressions simplifies the alinement of terraces.

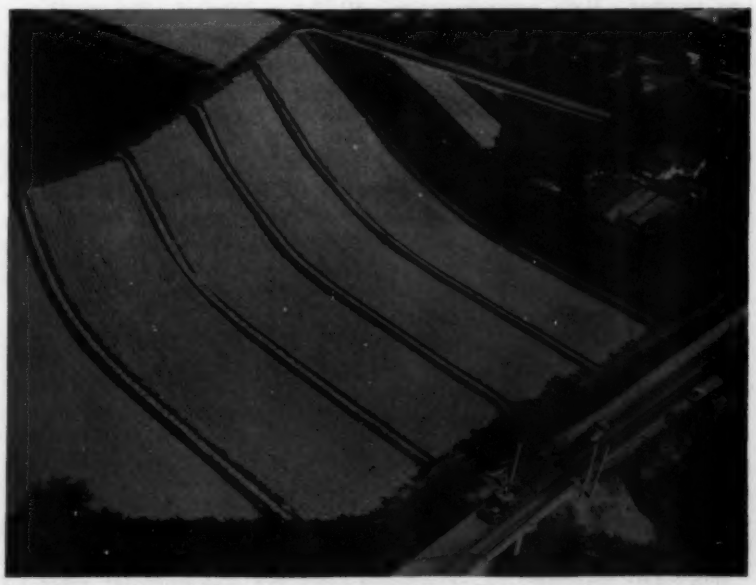
Not all land can be terraced economically with a parallel system, and it is seldom feasible to make all terraces in a field parallel. A nonparallel terrace interval located where slope changes abruptly will reduce the cost of alining the other terraces.

Cost records were kept during construction of parallel terraces and waterways on five farms in the Piedmont studies conducted by the Agricultural Research Service in cooperation with the Soil Conservation Service. Four of the systems were designed specifically for row crop fields and one for a peach orchard. The systems for row crops had spacings of 67 to 80 feet between terraces, depending upon the slope of each field. The terraces for peaches were 22 feet apart to permit a row of trees on each terrace ridge. The cross-section of these terraces was about one-third as large as regular terraces.

The locations for waterways were selected before laying out the systems. The soil removed from the waterways was used to fill gullies, dead furrows, and other low areas in the field. Then, old bench terraces were leveled and the entire field was smoothed to improve terrace alinement. The cost of this operation depended on how much soil was moved and how much smoothing was done. It ranged from $3.08 per acre where 256 yards was moved on 18.1 acres to $8.90 per acre where 1,494 yards was moved on 18.6 acres. The cost averaged $6.38 per acre for all fields studied.

The cost of land smoothing is the most variable item in constructing parallel terraces. It depends mainly on the amount of earth to be moved because of the prior condition of the field. The size and type of machinery also affect costs. Usually, the larger and more costly machines are the most efficient earthmovers per unit of time.

The cost of constructing waterways depends upon the amount of soil to be moved, which, in turn, is determined by the length and cross-sectional area of the waterway. The waterways on the five farms studied were constructed with several different types of



Aerial view of parallel terraces on a nursery in Tennessee shows the absence of point rows.

The author is research agricultural engineer, Southern Piedmont Soil Conservation Field Station, Southern Branch, Soil and Water Conservaton Research Division, Agricultural Research Service, Watkinsville, Ga.

A "bottomless" scraper smoothing the land between terraces.

An "elevating" scraper cutting a high spot from channel.

machines. The cost varied from $0.09 per cubic yard with a 4-cubic-yard elevating scraper to $0.12 per cubic yard with a bottomless scraper. Both scrapers were towed with 3- to 4-plow size farm tractors. Waterways on one farm were constructed with a track-type tractor towing an 8-cubic-yard scraper at a cost of $0.09 per cubic yard for 1,869 cubic yards of earth moved. Motor graders were used on two farms at a cost of $1.23 and $1.38 per 100 feet of waterway. Since motor graders only "roll" soil, it is not realistic to express the production on a per-cubic-yard basis.

A key terrace was laid out in each field after land smoothing was completed. Then other terraces were laid out parallel to the key terrace. Whenever it was not feasible to follow the key terrace, a conventional terrace interval was inserted and a new key terrace located.

Terraces with an average cross-sectional area of 9.2 square feet were constructed with motor graders at a cost of $0.67 to $0.75 per 100 feet and an average cost of $0.72 per 100 feet. The small terraces for peach trees cost only $0.28 per 100 feet. The terraces in one field were constructed with a two-bottom moldboard plow at a cost of $0.86 per 100 feet.

Costs reported here represent only the actual ownership and operating costs (fuel, engine oil, lubrication, etc., and operator's wages) and do not reflect rental or contract costs.

No. 75

This is the seventy-fifth of a series of articles to appear from time to time in explanation of the various phases of research being conducted by the Department of Agriculture on problems of soil and water conservation.

Have You Seen?...

● "Engineers in the Soil Conservation Service," USDA Miscellaneous Publication 956. The Soil Conservation Service carries on a wide variety of work that requires the services of engineers. This booklet describes and illustrates many of the activities in the field and office. It also emphasizes SCS's intensive and specialized training in many fields of engineering as well as its free specialized training in colleges and universities to highly qualified employees.

● "Soil Erosion, the Work of Uncontrolled Water," by R. D. Hockensmith and J. G. Steele of the Soil Conservation Service, USDA Agriculture Information Bulletin 260. Loosening soil particles by the impact of raindrops or by the scouring action of runoff, moving the detached particles by flowing water, and depositing the particles at new locations are the three principal steps involved in the process of soil erosion by water. The bulletin discusses this process in detail.

● "Watershed Protection, Flood Prevention Serves Land, People, Commerce, Industry," by the Soil Conservation Service, released by USDA. Railroads are an inseparable part of the Nation's watershed work. For example, 14 projects listed in this folder have helped to eliminate railroad damages caused by floods in Western United States. People, land, and industry are reaping unforeseen dividends from watershed work, including new opportunities for site developments, new housing, and improved locations for business and small industries.

◆

A soil psychrometer for measuring the relative humidity of air in the soil has been developed recently by the Department of Agriculture to aid basic research on soil moisture and the part it plays in plant life.

Watershed Project Protects Montana City Against Floods

By Donald J. Anderson

THE people of Plentywood in northeastern Montana are assured of a flood-free future since completion of a flood protection and fish and wildlife water-impoundment dam in the Box Elder Creek watershed just north of the Sheridan County seat.

The project, developed through the Watershed Protection and Flood Prevention Act (Public Law 566), was sponsored by the City of Plentywood and the Sheridan County Soil and Water Conservation District. The dam was built at a cost of $225,110. The Soil Conservation Service provided engineering services and $210,475 in cost-sharing of the structure.

The 90-acre lake to be impounded by the 60-foot high, 1,700-foot long dam will provide additional benefits in boating, fishing, and picnicking. The Montana Fish and Game Department contributed $15,000 for additional water storage for fish and wildlife purposes, and has tentative plans for stocking and managing the reservoir for trout.

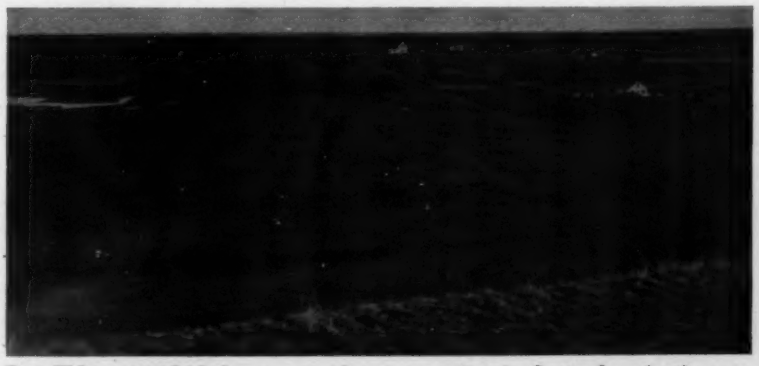
The dam was designed by Soil Conservation Service engineers to give maximum protection, both to the City of Plentywood and to the bottom-land area below. The flood-water-retarding capacity of the project is enough to handle two consecutive storms as big as the disastrous storm of 1953, although it is considered that kind can be expected in this area only once in 100 years or longer.

Mayor Vernon Christensen said in announcing acceptance of the Box Elder Creek project by co-sponsoring Plentywood:

"Our community has a big stake in this project. Protection against the threat of another devastating flood is something that we have desperately needed for the future development of our city."

Mayor Christensen and other local leaders are planning for the development of the area for recreation uses. This is the first project of the kind in Montana to be eligible for SCS assistance under the new authority for technical and cost-share help in specific kinds of recreation development connected with watershed projects, for the benefit of an entire community.

Most of the 18 landowners on the 20-square-mile drainage area above the lake are cooperating with the Sheridan County district. They are installing such soil stabilizing and improving measures as striperopping, contour cultivation, grassed waterways, and the proper use of range to insure a long and useful life for the project by forestalling rapid silting of the reservoir. The City of Plentywood has assumed responsibility for the maintenance of the flood-protection works proper.



Box Elder watershed dam was under construction in September (top), completed by the end of November (spillway in foreground).

The author is work unit conservationist, Soil Conservation Service, Plentywood, Mont.

An award-wi g p

Building a Floodw er

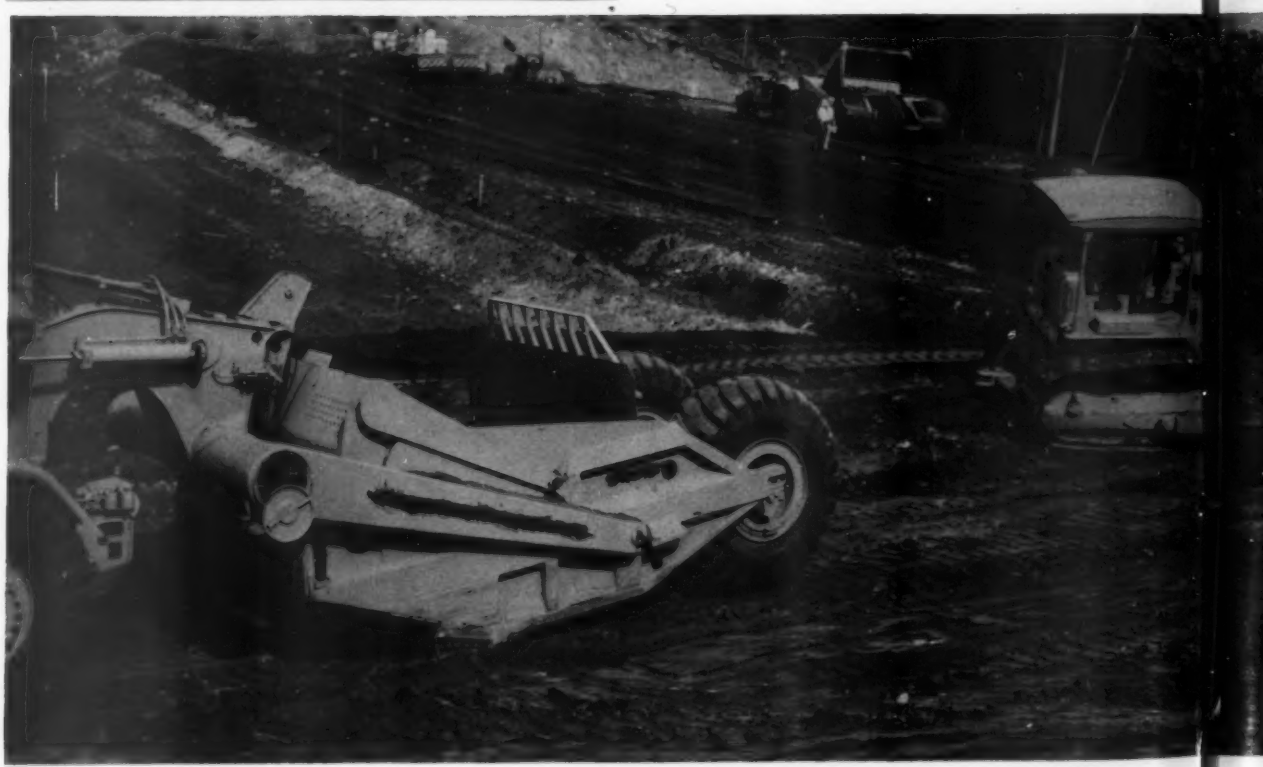
By Willia McCl

SPILLWAY EXCAVATION (Far L.). Area being exc TW vated for principal spillway pipe under the dam. structu

MECHANICAL SPILLWAY (Top L.). Workers joining se EA tion of concrete pipe in completed excavation. from

ANTISEEP COLLARS (Top R.). Concrete wings preve GR water from seeping along outside of pipe through dam. ermu

The author is soil conservationist in the Oconee Work Unit, Soil Con Servi



rd-wi picture story

oodwater-Retarding Dam

William McClure, Jr.

eing exc TWO-STAGE RISER (Far R.). Opening halfway up inlet structure slows flow of water from heavy rains.

oining se EARTH EMBANKMENT (Lower L.). Earth excavated from emergency spillway is compacted into dam.

gs preve GRASS COVER (Lower R.) Sprinkler irrigation helps start h dam. bermudagrass sprigged on dam and spillway.

. Soil Con Service, Walhalla, S. C.

Flood Prevention Story Gets Southeast Headlines

By Walter S. Allen

HEADLINES from the bayous of Louisiana to the Blue Ridge Mountains of North Carolina tell the story of how well small watershed protection and flood prevention projects have done.

Various recreational and other individual and community benefits also are reflected in the words of local people in the accompanying accounts. A half-dozen or so examples are representative of the flood-prevention headlines stories published all over the Southeast:

Seneca, South Carolina: Flood Dams in Coneross Tame Overflowing Creeks. — Two pictures told the flood prevention story. One, taken before the Coneross Creek watershed project was started, showed a road and bridge under water; the other, made after two dams were built, showed the same bridge and road dry and open to traffic.

The Blue Ridge Shrine Club has built a $5,000 clubhouse on a 2-acre lot overlooking one of the lakes.

Wynne, Arkansas: Watershed Project Protects Town. — O. H. Pool, long-time resident of Wynne, recalled: "I remember some big floods back in the '20's. We used sacks of flour for sandbags, but the water got 11 inches deep in the stores, anyway. But since we got the Caney Creek watershed project, the creek runs less than half full after the heaviest rain. The project also saves the farmers in the county about $150,000 a year."

Walnut Cove, N. Car.: Watershed Dam Increases Land Value Three Times.—"The value of land and crops in the flood plain has increased three times since this dam was completed," Ralph Mills, chairman of the Stokes County Commissioners, reported.

He was talking about the first dam completed out of 13 planned in the Town Fork Creek watershed. He said 3-inch rains flooded the area in the county outside the watershed.

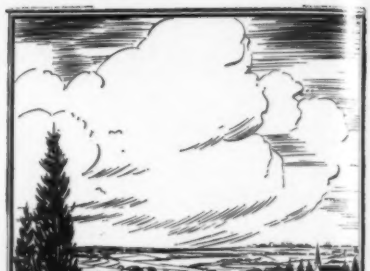
Plain Dealing, Louisiana: Ten-Inch Deluge Fails to Disturb Town. — Outside the Upper West Fork Cypress Bayou watershed floodwaters heavily damaged more than 300 acres of crops, washed out bridges, and stopped traffic on main highways. But the residents of Plain Dealing slept soundly, because they were protected by three floodwater-detention dams.

"It's the best thing that ever happened to our community," said Mayor Leon Sanders.

To which Curtis Gleason, local automobile dealer, added: "Before we had the watershed project, every store in town would have had water in it after a rain like that."

The town has developed a recreation area on 60 acres of land it owns around 2 of the lakes, where as many as 3,000 people a day have enjoyed swimming, boating, picnicking, and fishing. One of the lakes was enlarged to store water for the town and for industry, and another for recreation.

Roanoke, Alabama: $28,000 Saved in Bridges and Roads. — That was, in effect, what the Chambers County Commissioners Court reported taxpayers had saved in flood losses prevented since three dams in the High Pine Creek watershed project were completed in December 1961.



And God said, "Let the waters under the Heaven be gathered together unto one place, and let the dry land appear . . ."

"Before this dam was built and the channel completed I had no outlet to drain my 20 acres of bottom land," J. B. Birdsong, Jr., said of the benefits of one of the dams to his farm. "That land wasn't worth a dime an acre. Now, I wouldn't take $200 an acre for it."

This other headline in March 1962 is representative of those appearing, also, in earlier years since Congress in 1953 authorized Federal participation with States and local communities in small-watershed programs, developed through pilot projects designated by the U. S. Department of Agriculture's Soil Conservation Service, and through locally initiated 1954 Watershed Protection and Flood Prevention Act projects:

Coffeeville, Miss.: Heavy Rains Fail To Flood Town. — "If that (the rains) had happened before the Turkey Creek watershed project was built you could have floated boats in and out of the stores," said A. A. Bryant, president of the Chamber of Commerce.

He said the project protects the town and some 4,000 acres of good bottom land that formerly was flooded after every heavy rain.

The author is field information specialist, Soil Conservation Service, Spartanburg, S.C.

Was the Ohio Flood Necessary?

By H. O. Ogrosky

SINCE the devastating flood on the Ohio River in March, the Soil Conservation Service has received many inquiries about the possible effects of small watershed projects in major storms such as that one.

The Soil Conservation Service, the Weather Bureau, and the Geological Survey are still gathering information on the Ohio valley storm and resulting runoff. The data already at hand clearly show that this was an exceptional event of a kind that makes complete defense uneconomic and impractical.

Watershed treatments of the kind carried on by soil conservation districts and other local sponsors with the assistance of the SCS can reduce damages on small tributaries but they cannot prevent flooding of major stream valleys after rains of such magnitude.

The March 10 edition of *The Post and Times-Star,* Cincinnati, Ohio, carried the following reports on the flood situation:

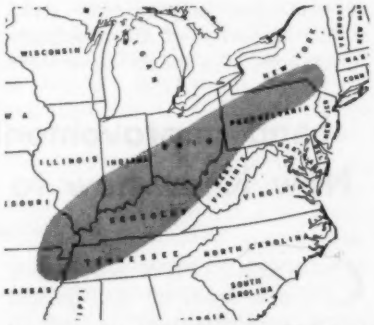
"Record rains spilled floodwaters from Arkansas to Pennsylvania today, driving more than 4,000 persons from their homes . . .

"Kentucky reported 3,000 persons evacuated from homes . . .

"Disaster crews in Poplar Bluff, Mo., worked feverishly through the night with highway police, national guard and army units to lead sleepy residents from their homes before the rain-swollen Black River smashes through a levee . . .

"Steady rains throughout Ohio forced many families from their homes . . .

"In Indiana at least 25 roads were blocked by high water and flash floods throughout the southern part of the State."



Area of excessive rainfall, March 3 to 10.

The general area of heavy precipitation covered a band roughly 150 miles wide from northeastern Missouri to New York. The amount of rainfall on March 3 to 10 is something that people living in the area will probably not see again. No doubt, most of them will be well pleased if they do not.

In Paducah, Ky., for example, 5.6 inches of rain fell on March 3 and 4. Another 3.5 inches fell on March 8 and 5.7 inches on March 9. This amounts to 9.2 inches in 2 days and 14.8 inches in 7 days.

According to studies by the Weather Bureau for the SCS (in press) the rainfall that can be expected once in 100 years on the average at Paducah is 8.2 inches in 2 days and 11.5 inches in 7 days. The reported 14.8 inches in 7 days can be expected at Paducah about once in 1,000 years, and the 2-day rainfall of 9.2 inches can be expected about once in 250 years. Regardless of the statistical estimates of occurrence, the March storm was a big and unusual rainfall. Although the amount varied

The author is hydrologist, Engineering Division, Soil Conservation Service, Washington, D. C.

Flooded feedlot on West Fork of White River, Iindiana.

from place to place, it provided a severe test to some 70 small watershed projects in 9 States.

Reports are still being received on the functioning of SCS-designed structures throughout the storm area. Some emergency spillways needed maintenance work after the runoff subsided, but there was no indication that any dam was overtopped. The maximum water level in one structure in Kentucky, however, came within 0.2 foot of the top of the dam.

Even though rains of higher intensity may create greater flood peaks, the storm of March 3-10 provided a good test of SCS hydrologic design. It indicated that present criteria are adequate but that any design level below the current minimum for each class of structure would be subject to question. The rainfall at Paducah, exceptional as it was, was well below the minimum design capacity of the structures. For example, "class a" structures to protect remote agricultural land of low value will pass runoff from 7.8 inches of rainfall in 6 hours, and "class c" structures above residences and important public utilities will handle runoff from 28 inches of rainfall in 6 hours. These capacities far exceed the 5.7 inches that fell in 24 hours on March 9, and the "class c" structures have double the capacity needed for the 14.8 inches of the entire 7-day storm.

Since it is not economical to provide complete protection from such unusual storms, the runoff is bypassed through emergency spillways. This does not mean that there will be no damage in watershed projects, but that flooding is held to a minimum consistent with the economics of each situation. The emergency spillways are needed only for rare occasions and generally need some maintenance after being used.

Small watershed projects are not designed to prevent floods on major rivers such as the Ohio. Although they may reduce damages on the larger rivers, their primary purpose is to give a specified degree of protection to certain areas within the tributary watersheds. Where the endangered land is in pasture or similar agricultural use, only a low level of flood protection is justified. Where high-value agricultural land and crops are involved or urban communities are affected, a much higher degree of protection is provided. Even if the majority of the tributary watersheds of a major river were protected by small watershed projects, the runoff bypassed by emergency spillways might be expected to result in some flooding on the main stem after such exceptional storms as that of last March.

To date the full story of the effectiveness of the 70 small watershed projects in reducing flood damage during the period March 3 to 10 is not known. Information is being collected, however, which will contribute much to the store of hydrologic and other related data in planning future projects.

Land Improvement Contractors Bring New Know-how to Conservation Work

By Leonard Morris

CONSERVATION contractors, a new breed of builders and doers, are important in getting conservation work done. They cooperate with soil conservation districts and the Soil Conservation Service to form a sort of conservation triad that has done much for the spread of engineered soil and water conservation construction.

Before World War II conservation practices on farms in the United States fell largely in the "do it yourself" category. A bumper crop of leaflets appeared with instructions on such things as building terraces with "your own moldboard plow." In those days the slip scraper and the "tumblebug" were used to install practices requiring earthwork.

After the war the demand for installation of carefully planned and designed soil and water conservation construction gave rise to the soil conservation contractor to build terraces, install draintile, construct dams, or apply other conservation measures.

As the conservation concept spread, the growing corps of conservation contractors became aware of a need for greater know-how and skill in the art of land improvement. They sought to fulfill this need for professional training by organizing into district and State groups. Their purpose . . . "to sponsor schools which would help them become professional land improvement contractors.

Out of this developed the Land Improvement Contractors of America with affiliates in 15 States and Canada. Their objectives embrace advancement of responsible administration of soil and water conservation programs, high quality workmanship, and professional competence.

Land and water contracting today is a $1 billion business. It offers a solution to many of the problems of farmers and other landowners. It contributes to the economy in areas of construction and it increases production of plants which manufacture machines and equipment used in conservation construction.

Conservation contractors have been a sort of catalyst in this economic mixing bowl. Their quest for professionalism will make theirs an ever important role in the continuing task of saving more soil and water for use in the Nation's growing economy.

The author is president, Land Improvement Contractors of America, Corning, Iowa.

Water Leveling Louisiana Riceland Saves Labor and Irrigation Water

By K. V. Stewart, Jr.

RICELAND in the coastal prairie section of southwestern Louisiana can be leveled successfully when the land is flooded with water if the soil is of sufficient strength to support mechanical earthmoving equipment when the top 4 to 6 inches is saturated. This method has been successful on the Crowley, La., Rice Experiment Station and is now generally known in the rice area as "water leveling" riceland.

The land-leveling method does not require surveying, since the water acts as a natural level. And the method is well adapted to southwestern Louisiana because of the high annual rainfall, most of which falls during the time when the land would be available for smoothing or leveling.

Most of the rice area in southwestern Louisiana has a natural or artificial hardpan 8 to 12 inches under the soil surface, which permits the operation of rice farm tractor-mounted graders and levelers when the land is flooded. Crowley and Midland silt loams naturally have hardpans that make water leveling feasible. Other soils may have too high a clay content to support mechanical earthmoving equipment, and some areas have topsoil too shallow to permit the depths of cut required.

Using the results of the Crowley experiments and working with soil conservation district cooperators, the Soil Conservation Service has developed standards and specifications for water leveling.

The usual survey procedure is to eliminate every other old contour levee, or retain one of every 3, 4, or 5 old levees, and realine the remaining key contour levees. Key levees are laid out as smooth curves, or are run straight without curves, depending on the topography.

Farmers like the resulting fields because they have fewer levees to take up space and reduce rice yields. Levees also are a source of grass seed infestation for the rest of the field. Fewer levees require less labor in flooding and flushing operations.

In the leveling procedure the soil is worked into a loose seed bed with turning plows and disk harrows. The entire area between the levees is then flooded to completely saturate the soil. The soil under water is moved from the higher to the lower parts of the area.

An SCS study of two fields which had been water leveled in the Acadia Soil Conservation District showed that proper water leveling can greatly reduce the number and length of contour levees. Cooperator Lyle Fogleman reduced the number of levees on his farm from 11 to 3 and the length of the levees from 8,350 to

The author is State conservation engineer, Soil Conservation Service, Alexandria, La.

Water serves as a natural level for tractor operators smoothing land in ricefield.

3,000 feet. Floyd Richard reduced the number of levees on his farm from 17 to 3 and the length from 15,150 to 3,850 feet.

Water-leveled fields also generally require less water for flooding. The U. S. Department of Agriculture reported 429,530 acres of rice harvested in southwestern Louisiana in 1959. If all this area could be water-leveled and the average water requirement reduced by 10 percent, it is estimated that the total saving would amount to about 23 billion gallons a year. In actual practice the amount of water saved varies considerably, depending upon topoggraphy, the efficiency of the old irrigation system, and the planning of the new system. In some cases there may be little or no saving of water.

Water leveling is becoming popular with rice farmers. In the Acadia district alone, the SCS helped district cooperators lay out new levee systems on 2,500 acres of land during the past 2 years.

Cost-sharing for water leveling riceland is now being provided under the Agricultural Conservation Program on land which had not previously been smoothed under the ACP.

Horace Arceneaux, chairman of the State ASC Committee, says:

"I think water leveling is a completion job on land that has previously been smoothed. There is no doubt it is a big help in the prevention of erosion. It is also an improved water conservation practice. Water leveling, compared to land smoothing, is like comparing a good concrete highway to the old time gravel road."

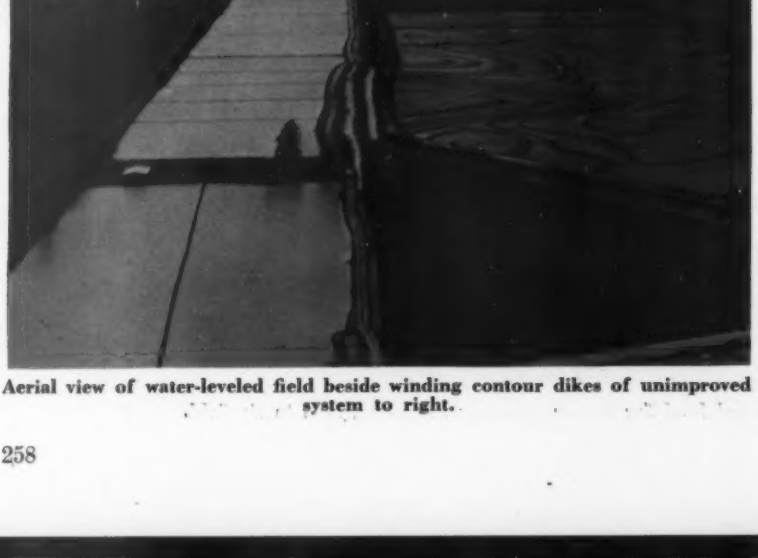
M. W. Scanlan, Jr., chairman of the Acadia district, says:

"All you have to do to see how this practice is catching on is take a plane ride from Crowley to Lake Charles."

Fogleman, president of the Acadia Paris Cattlemen's Association, says, "I think enough of it that I plan to level all the land I operate within the next 3 years."

Causby Hamic, Jr., rice and cattle farmer, says:

"It pays to water level just for the amount of labor saved in flooding the fields and the time it takes to check the field. The first field I leveled, we eliminated more than 15,000 feet of levees."



Aerial view of water-leveled field beside winding contour dikes of unimproved system to right.

Basin Irrigation System Stops High Pumping Costs

By John Colvin, Jr.

HIGH pumping costs used to make it "tough" for Arizona Farmer Jay Wilson to grow crops on his ranch in Casa Grande.

Now a newly installed basin irrigation system permits him to cover 140 acres instead of 100 with the same amount of water —a 40 percent increase in irrigation coverage at the same cost.

Wilson talked things over with technicians of the Soil Conservation Service, working through the West Pinal Soil Conservation District, and also made application for Agricultural Conservation Program cost-sharing funds in order to level some of his farm.

This matter of irrigation on flat land or sloping land had puzzled Wilson for some time.

Flat fields required less water and made as much or more cotton in almost every case. Twenty-five percent more water was used on the slopes.

After getting information such as this from field trials, he set up a system that required less water to get the job done.

Wilson "bench-leveled" his farm, which required cutting quarter mile runs to an eighth of a mile and taking out the sidefall so he could basin-irrigate the fields.

Some folks said it would cost

The author is soil conservationist, Soil Conservation Service, Yuma, Ariz.

too much to farm the small patches and more fields would be needed.

There were advantages to long runs, but there was the problem of getting the most from his water on those big fields. Shorter fields saved water. Benching meant less dirt to move, shallower cuts, and shorter, less expensive hauling.

SCS engineers planned a 40-acre field with about 0.1 foot fall per 100 feet that would result in a sloping field with a long run. This work called for moving about 23,000 cubic yards of dirt.

The field was also figured in two 20-acre blocks with 0.2 foot total end fall in runs of 660 feet without sidefall. The shallower cuts of this plan required less than 19,000 yards to be moved. The plan included one-fourth mile of ditch to control water over the irrigation run. This is the plan he installed.

When the job was done on the short runs, Wilson planted sudangrass to get humus into the soil and provide pasture for cattle.

Irrigations were different than any he had tried. He moved four or five big siphons about 50 feet every hour. No water ran off the end of the field, and there were no dry spots or holes to shovel water in or out.

What made Wilson smile—when water was put on, it stayed. By putting his 1,350 gallon per minute head onto one ¾-acre border, he could get the water to the end of the field in about 15 to 20 minutes, and then let it fill the border to the desired depth. This usually took about 45 minutes more and resulted in an application of about 4 acre-inches. Water was 2 or 3 inches deep when he changed it, and it disappeared in about an hour's time.

No question where it went. No water got out of the field except down through it.

He determined how much water was needed at irrigating time by estimating available moisture in the root zone, and then irrigating enough to fill the soil to capacity.

Water runs off where slope is too steep and run too long.

Good irrigation results from good leveling.

The rate at which he covered a border allowed exposed ground surface an equal chance to absorb water. Penetration was about the same on the entire border.

The whole border or field was treated as a unit rather than trying to "irrigate to suit the dry zone" and ending up with more water on the upper end than needed or running tailwater off the lower end.

Wilson planted a green manure crop of barley in the fall and pastured it four times before the cold weather stopped the growth and the field was put into cotton. Water used on the barley was about 30 inches, going into the soil uniformly.

Wilson sums it up like this:

Water is limited and expensive in the Casa Grande area and must be conserved.

Wilson is doing just that.

"Watershed Philosophy" Spreads Along Hadley Creek and Beyond

By Hampton H. Long

A "WATERSHED philosophy" akin to that of "soil stewardship" distinguishes the thinking these days of people living along Hadley Creek in Illinois' westernmost Adams and Pike counties.

When the Hadley Creek watershed project was first started in 1955, very little conservation work had been done on the 46,000 acres. On some fields one-quarter to one-half of the topsoil had been lost. The work that had been done was on an individual basis.

Hadley Creek was one of the 60 pilot watershed projects in the United States authorized by Congress back in 1954. As the work progressed, a watershed philosophy developed among the people living on the watershed. People began to take pride in the amount of total conservation applied in the watershed and on their own farms. They began to see the advantages of working together.

Dewey Andrews, dairy farmer, says, "I feel that the dividends we farmers receive from the project will continue to come in as long as we are willing to follow the conservation practices that go hand-in-hand with the major structures.

The Federal Government, through the Soil Conservation Service, helped pay for the construction of the larger structures that usually benefited at least 3, and sometimes as many as 10, farms. They reduced floodwater and stabilized gullies. Henry Shuster, who lives one-half mile below the largest dam in the watershed, says, "I didn't see how that dam could do much good; but, do you know, since it was built I've never seen the time I couldn't wade across the creek with knee boots on? We've had some awful rains, too. Before, we could expect the water to come clear up to our yard fence."

Schuster was talking about a dam that held back floodwater from 7,000 acres and let it out through a 36-inch pipe so slowly that there was no flooding.

In the uplands behind the structures, the people worked together in cooperation with the Adams County and Pike County soil conservation districts to apply terraces, trees, ponds, small structures, contour farming, and other conservation measures necessary to reduce soil and water loss. They built 190 miles of terraces, planted 60 acres of trees, contoured 6,000 acres of cropland, improved 2,000 acres of pastures, and devoted 536 acres to wildlife cover. Fishing is excellent in the 200 lakes and ponds. Rabbits, quail, and deer are on the increase.

The people in Hadley are proud of their accomplishments and they should be. They have the satisfaction of people working together to solve the flooding and erosion problems. They acquired the "watershed philosophy," the knowledge that conservation practices applied on a watershed basis benefit all. This philosophy has spread to other people and other areas.

Today, within 50 miles of Hadley Creek, five other watershed projects are either in operation or are being planned. Big Blue Creek near Pittsfield, Ill., is a water supply for the town, and Hambaugh-Martin near Versailles protects bottom land from flooding. Plans are being prepared for North Fork of McKee Creek and Middle and South Forks near Mt. Sterling, and an application has been submitted for the Coal and Crane creeks near Rushville, Ill.

As Mrs. Webster Sykes of Barry says, "This Hadley Creek project is the best thing that ever hit this community."

Stripcropping protects the uplands in the Hadley Creek watershed, Illinois.

The author is area conservationist, Soil Conservation Service, Macomb, Ill.

The completed land-leveling job is checked by soil conservation technicians on E. I. Stamford farm.

Land Grading Raises Yields And Benefits Rural Economy

By Robert H. Landers

FARMERS, soil conservationists, and soil and water conservation district supervisors in southeast Missouri are placing more emphasis on good land preparation in a well balanced soil and water conservation program.

In this area of deep fertile soil, high annual rainfall but frequent summer drought, and flat topography, land grading is needed for the dual purpose of removing excess water and efficient distribution of irrigation water.

Land grading is an exacting earthmoving job that must be carefully planned and installed with meticulous attention to every detail by the landowner, the contractor, and the Soil Conservation Service technicians who provide the plans and check the completed work.

R. B. McCord and his operator, William Fortner, are good examples of working by a basic farm conservation plan. The two men became cooperators with the New Madrid County Soil and Water Conservation District in 1956. Their 640-acre farm is located near Tallipoosa, Mo.

Preliminary work before grading began with a soil survey and topographic survey of the farm by the SCS. After these surveys, the basic farm conservation plan was prepared and the SCS engineer provided the cooperators with detailed grading plans as the work progressed. These plans were based on engineering surveys made on a 100-by-100-foot grid from which a design sheet was prepared. The "cut" sheet furnished the farmer or his contractor showed cut and fill, amount of earth to be moved, required grades to be used, location of surface drainage ditches, and existing field ditches to be eliminated. Special detailed soil surveys were used as needed to base designs on properties of the soil, such as infiltration rate, that govern length of runs and slopes of rows.

McCord and Fortner's plan showed a need for 6 miles of drainage ditches, both mains and laterals, and the grading of 600 acres for drainage and irrigation. Fourteen irrigation wells were located. When completed, they ranged in depth from 45 to 75 feet and produced an average of 450 gallons of water per minute per well.

McCord and Fortner, since starting on the plan in 1957, have constructed 26,780 linear feet of ditches and have graded 625 acres. They moved 165,000 cubic yards of earth, all with their own equipment, which includes a 6½-yard scraper and a 45-foot leveler. They installed 2,000 feet of 6-inch and 1,300 feet of 5-inch aluminum gated pipe and 3,000 feet of flexible rubber tubing. These along with eight small portable irrigation pumps fulfill water and irrigation equipment needs.

Charles Meunier, SCS work unit conservationist, and E. B. Nace, associate director of the Missouri Agricultural Extension Service, have worked closely with the cooperators on their soil fertility program, as have commercial fertilizer and irrigation specialists. The rotation after land preparation is 2 years of corn, 1 year

Work Unit Conservationist Charles Meunier finds proof of value of land grading on McCord-Fortner farm.

The author is agricultural engineer, Soil Conservation Service, Cape Girardeau, Mo.

of cotton, 1 year of beans, then back to corn. They seed 320 acres of rye and vetch for cover crops each fall, to be plowed under the following spring for green manure.

A complete record system was worked out by the Missouri Extension Service, which proved valuable in showing the operators the gains in per-acre yields resulting from the land preparation and improved soil management.

In 1963, Missouri farmers cooperated on land preparation with eight soil and water conservation districts in the greater Mississippi River alluvial basin area of southeast Missouri where a million acres could be improved by this conservation practice.

Two hundred and eighty-two farmers made plans and the SCS gave planning assistance and provided engineering designs for 336 jobs, requiring the moving of 3,604,368 cubic yards of earth and 42,198 feet of corrugated metal and irrigation supply line pipe at an estimated cost of $801,517.

Cost of land grading in this area ranges from $25 to $100, with an average of about $50, per acre. The amount of earthmoving required ranges from 150 to 600 cubic yards per acre.

This work uses many kinds of equipment and structural items. It not only improves farmers' and contractors' incomes but also helps others allied with farming and construction. For example, the petroleum industry, machinery and equipment manufacturers and dealers, the fertilizer and chemical business, well drillers, pumping and irrigation equipment manufacturers, and labor all play a part and share in the benefits.

Many of the larger landowners, such as R. B. McCord, own their own special equipment. Farmers in southeast Missouri, according to one equipment distributor, have purchased 25 sets of tandem scrapers (4- and 5-yard capacity) and 12 landplanes from his company alone this year.

Elementary Teaching Students Tie Conservation to Subjects

By John M. Cross

A JUNIOR class in elementary education at the University of Southwestern Louisiana developed its own plan for teaching about soil conservation and related resource problems by tying it to subjects taught in the State's upper elementary grades.

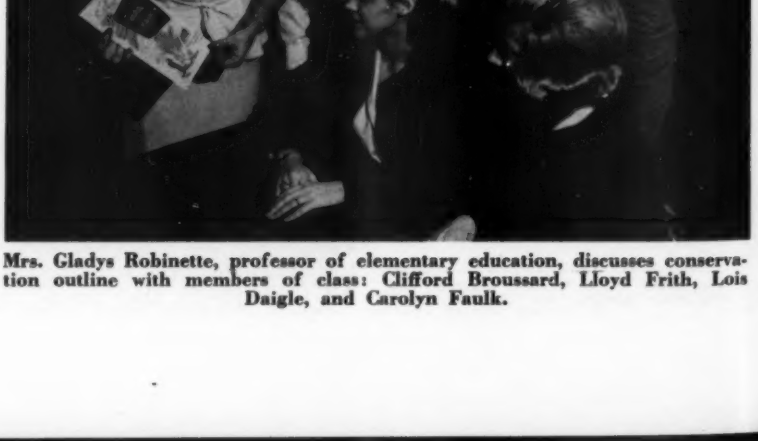
Under leadership of Mrs. Gladys Robinette, professor of elementary education, several objectives were set forth by the class in the beginning. This one basic objective was to develop understanding, awareness of, location, importance, and the benefits of natural resources. Improvement of habits and providing opportunities to develop skills in conservation by the children were included. The very approach to the subject, defined beforehand as "conservation is wise use," was a study in itself.

The class, one in teaching methods, divided into groups. Each group selected one area of study —soil, water, forests, grassland, seafoods, minerals, or wildlife— and outlined its course of action. To orient their thinking on the grade level and keep it simple and direct, the students asked themselves:

"What would I need to know about conservation if I were an eighth grade student?" Even their sources of information were confined to those available at local levels.

They evaluated each source of information on conservation with a critical eye. They looked into publications of the Soil Conserva-

The author is assistant State soil conservationist, Soil Conservation Service, Alexandria, La.



Mrs. Gladys Robinette, professor of elementary education, discusses conservation outline with members of class: Clifford Broussard, Lloyd Frith, Lois Daigle, and Carolyn Faulk.

Ryan Fontenot explains Louisiana water resources.

Class member Lois Daigle uses teaching outline.

tion Service and other agencies. They viewed films from the University library. Elizabeth Kaack of Baton Rouge, visited the local headquarters of the Grand Coteau Ridge Soil Conservation District.

Diana Domingue of Erath made a simple drawing showing how soil is formed. Ryan Fontenot made a map showing the importance of rivers to the welfare of Louisiana. "Demons of Erosion" was the subject of an example poster made by Kathryn Pesson, a student from New Iberia. These all were activities they likely would ask eighth graders to do.

Each group shared its findings with the entire class, and all the information was recorded for reproduction. Not only did the students learn methods of teaching in the course, but they also gathered much information about conservation of natural resources.

As a result, they will be prepared to handle the course in natural resources conservation taught in the junior high schools of Louisiana, and also to relate conservation to many conventional school subjects, such as social studies, mathematics, history, and language arts.

Mrs. Robinette, who is secretary to the Louisiana Advisory Committee on Conservation and Resource Use Education of the State Department of Education, thinks conservation should be taught, not just accidentally or incidentally, but systematically by relating it to subjects taught. That is what the "Education 327" class at Lafayette is prepared to do.

Electronic Surveying In Watershed Projects

The traditional rod and chain method of surveying can be beaten two to one by using a newly perfected two-unit portable electronic measuring device that has undergone nearly a year of field tests by the Soil Conservation Service.

The SCS Cartographic Division has found the instruments to be especially useful over rough terrain and around bodies of water, which are extremely difficult to chain. The units have been used primarily in widely scattered upstream watershed projects where immediate topographic maps are needed.

The new device measures in billionths of a second the time it takes a radio micro-wave to travel from one unit to the other and back again. This time lag is registered on a dial on the master unit and then converted to feet or meters. The instruments establish the horizontal and vertical control needed for the construction of topographic maps from aerial photographs.

The 25-pound units are powered by a 12-volt storage battery or a self-contained power pack. Operators of the two units communicate via built-in radio telephones or walkie-talkies.

The radio waves can penetrate a light stand of trees or brush, but they cannot shoot through a hill or thick forest. Measurements may be made through haze, mist, clouds, or light rain, day or night. Corrections and computations that have to be made are reduced to a matter of minutes by the new instruments, instead of hours required when the chain method of surveying is used.

A survey of 60 courses in 10 widely scattered watershed projects in Virginia took 14 days, including traveling time. It would have taken at least four times as long to get the measurements by chaining. In another test, in west Texas, the instruments in 2 weeks got readings that would have taken 4 to 5 weeks with conventional equipment.

The instruments were developed primarily for long-range measurements of 40 miles or more, and are correct to within a few inches even up to such distances.

The tellurometer for one unit. (Auxiliary equipment not shown.)

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THE CARE OF THE EARTH. By Russell Lord. 480 pp. 1962. Thomas Nelson & Sons, New York. $7.50.

Without spelling it out in so many words "The Care of the Earth" is a relation of man's stewardship of the soil from earliest times to the present.

It is not a conservation book per se but, as its subtitle makes plain, "A History of Husbandry," the author's announced aim of which is "to outline the history of agriculture through advancing frames of time." However, figuring prominently in the step-by-step telling are soil and water conservation problems, programs, and advancements in the United States since the historic governors' conference on conservation called by President Theodore Roosevelt in 1908.

As the framework for spanning 72 centuries in his 480-page narrative, Lord revives the time lapse projection he advanced as an imaginary motion picture film in the Soil Conservation Service's first national bulletin, "To Hold This Soil," in 1938—24 years of change in a second, 1,440 years in a minute, 86,400 years in a year. The soil stewardship concept is reflected particularly in a number of references to and quotations from the Bible. As the book points out:

"The authors of the Bible, in their time, learned a great deal about the vital relationships of soil, rain, and man, and learned it the hard way. If the sequences of their racial experience are arrayed in the order of causes and consequences, no other single book contains as vivid a record of promised plenty followed by dispossession and despair."

By New Testament times, it is pointed out, conditions had changed; "and there had been by that time, unquestionably, . . . a diminution in the soil."

Drawing liberally upon the findings of contemporary and earlier conservation authorities in confirmation of what has happened to America's and the world's land and water resources, Lord draws this terse conclusion: "The problem of preserving the soil is still with us, and must be solved if modern civilizations are to survive."

Although much of the veteran conservation writer-editor's presentation has a familiar ring to his long-time readers, he has, with considerable skill, brought the highlights of trends in soil and water use and problems up to date with respect to growing urbanization and other aspects that today are broadening the conservation approach. He asks, for example: "What happens when a native rural population runs thin on soil and low in money in their home part of this land and starts to peddle their climate, cool or warm as the case may be, the remnants of their unspoiled pastoral or woodland calm and scenery, and such charms as remain in their historic rural traditions and landmarks to the urban swarm?"

All in all, Russ Lord has put on paper a collection of facts and documented references that make "The Care of the Earth" a particularly helpful volume for younger conservationists and a refresher source for the old timers in this field.

FRANK B. HARPER

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"We are standing at a point in time, at a place in the history of the world, when the very wisest use of our natural resources for the benefit of the whole free world is basic to the survival of human freedom—and on this depends the future of mankind on this earth."

—WILLIAM R. VAN DERSAL